

**In the Claims**

The applicants have not amended any of the claims in the application and thus, the claims stand as filed.

## Discussion

In a Non-final Office Action dated March 22, 2004, the USPTO rejected Claims 1 - 7, 9, 11 - 14, 16, and 18 - 22 under 35 USC § 103 as being unpatentable over Hindin, et. al., U.S. Patent No. 3,945,946. The USPTO also rejected Claims 8, 10, 15 and 17 under 35 USC § 103 as being unpatentable over Hindin, et. al. and further in view of Shinohara, et. al., U.S. Patent No. 3,976,034. The USPTO also rejected Claims 1 - 20 under 35 USC § 103 as being unpatentable over Zimmerman, et. al., U.S. Patent No. 5,378,350, taken with Hindin, et. al. and Ahlberg, U.S. Patent No. 2,374,404. Finally, the USPTO rejected Claims 1 - 7, 9, 11 - 14, 16 and 18 - 20 under 35 USC § 103 as being unpatentable over Ahlberg taken with Hindin, et. al. The applicants respectfully traverse each of these rejections.

## Failure of cited references to teach the use of "eta" alumina.

### Introduction

The applicants respectfully request that all rejections under 35 USC § 103 based on Hindin, et. al. be withdrawn. Hindin, et. al. is the only reference cited by the USPTO as teaching the use of eta alumina as a carrier. The USPTO acknowledges that NONE of the other cited references even imply the use of eta alumina. (In fact, Zimmerman, et. al. fails to mention any specific types of alumina and Ahlberg mentions only alpha, beta and gamma alumina.

(p.2, col. 1, lines 12 -13))

Hindin, et. al. fails to specifically teach the use of any particular type of alumina, and thus, implies to a person skilled in the art that any of the disclosed aluminas would be acceptable as carriers for the catalysts disclosed in Hindin, et. al. In contrast, the applicants have discovered that one particular form of alumina is superior to all other forms of alumina as a carrier for a particular dehydrogenation catalyst.

#### **Analysis of Obviousness Rejections**

The USPTO has established a three step process for proving *prima facie* obviousness under 35 USC § 103. (MPEP 2142 - 2143) The first step requires the examiner to set forth the differences in the claim over the applied reference or references and to explain the suggestion or motivation in the reference which would encourage a person skilled in the art to modify the reference. The second step requires the examiner to prove that the proposed modification of the reference(s) would be likely to arrive at the claim's subject matter. The third step requires the Examiner to explain why the proposed modification would be obvious and how it teaches each claim limitation.

In the Office Action, the USPTO acknowledged that Hindin, et. al. fail to teach the preferential use of eta alumina as the carrier for the catalyst of the invention. Rather, the USPTO

suggests that the carrier of Hindin, et. al. could be modified to be produced from eta alumina as that choice is an "obvious expedient to optimize a catalyst..." (page 2).

The applicants respectfully assert that the USPTO has failed to satisfy its burden to establish *prima facie* obviousness. The USPTO is required to identify where in Hindin, et. al. there is a motivating suggestion to choose eta alumina as the carrier material above all of the types of alumina that are disclosed therein. Such motivation is not present. There is no statement in Hindin, et. al. of a preference for any particular type of alumina and certainly no preference for the use of eta alumina. In In re Jones, 958 Fed.2d 347, 21 USPQ 2d 1941, 1944 (Fed. Cir. 1992), citing In re Lalu, 747 F.2d 703, 705, 223 USPQ 1257, 1258 (Fed. Cir. 1984), the Court stated that "[t]he prior art must provide one of ordinary skill in the art the motivation to make the proposed... modification needed to arrive at the claimed compound." The USPTO has failed to disclose any suggestion or motivation in Hindin, et. al. to utilize eta alumina over any of the other aluminas that are listed.

Moreover, the USPTO has failed to prove that the use of eta alumina as a carrier is a "desirable" modification. The "desirability" of the motivation must also be proved to establish *prima facie* obviousness.

The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make modification obvious unless the prior art suggested the desirability of the modification. In re Fritch, 922 Fed.2d 1260, 23 USPQ 2d 1780, 1783-84 (Fed. Cir. 1992.)

In addition, the USPTO has failed to show that the motivating suggestion to use eta alumina, which is not present in Hindin, et. al., is "explicit" and not merely a vague reference to a possible modification.

...invention can not be found obvious unless there was some explicit teaching or suggestion in art to motivate one of ordinary skill to combine elements so as to create same invention. Winner International Royalty Corp. vs. Wang, 48 USPQ 2d. 1139, 1140 (D.C.D.C. 1998). (Emphasis supplied)

Clearly, there is no teaching of a motivation within Hindin, et. al. that it would be preferable to use eta alumina as the carrier, nor is there any teaching of the desirability of such modification, much less an explicit teaching of the use of eta alumina as a carrier.

**Unexpected results from the use of eta alumina as a carrier.**

In addition to the deficiencies in the USPTO's proof of *prima facie* obviousness, the applicants respectfully assert unexpective results from the use of eta alumina. The USPTO has acknowledged that a *prima facie* case of obviousness is "rebuttable by evidence of superior or unexpected results." MPEP 2144.09, see In re Papesch, 315 F2d 381, 137, USPQ 43 (CCPA 1963).

Attached as **Exhibit A** is an affidavit under 37 CFR 1.132 by applicant Fridman, wherein he asserts that the catalyst of the

invention, wherein the carrier comprises eta alumina, performs surprisingly better than similar, conventional catalysts, wherein the carrier comprises gamma alumina.

To understand why this is such a surprising result, it is important to review the types of alumina that are commonly used as carriers for a catalyst, particularly a dehydrogenation catalyst. Mid to high surface area gamma alumina has consistently been the preferred choice as the carrier for such catalyst as disclosed, for example, in U.S. Patent Nos. 2,956,030, 2,945,823 and 2,374,404. (Note that U.S. Patent No. 2,374,404 (Ahlberg) is cited as a prior art reference by the USPTO.)

In addition, the prior art has established that gamma alumina is the preferred material for use as a carrier over eta alumina for dehydrogenation catalysts. For example, in Tsuchida, et. al., "The effect of Cr<sup>3+</sup> and Fe<sup>3+</sup> ions on the transformation of different aluminum hydroxide to alpha-Al<sub>2</sub>O<sub>3</sub>", *Thermochimica ACTA*, 64, pages 337 - 353 (1983). (Copies of each article cited herein were provided to the USPTO in an IDS dated July 1, 2002.) This article states that during the formation of alpha alumina containing Cr<sup>3+</sup> ions, the transformation of bayerite-containing chromium ions from eta alumina to alpha alumina was "accelerated". In contrast, the transformation of boehmite-containing chromium ions from gamma alumina to alpha alumina was "inhibited". Acceleration of transformation to alpha alumina, as is exhibited when eta alumina

is heated, results in a reduced stabilization of the catalyst while inhibition in the transformation, as is exhibited by gamma alumina, enhances stabilization of the catalyst end product. The preference for gamma alumina over eta alumina is thus clear, especially because dehydrogenation catalysts are routinely heated to high temperatures.

The preference for gamma alumina as the support material for catalysts in general, especially where enhanced stability at higher temperatures is required, is also discussed in Richardson, James T.; *Principles of Catalyst Development*, (1989). The preference for gamma alumina as a support materials is specifically discussed at pages 35 and 36, especially in a situation where a small quantity of zirconia is added to the alumina to stabilized the catalyst. This is exactly the addition made to the catalyst of the invention.

Another example of the preference for gamma alumina over eta alumina as the material to be used to form the carrier of a dehydrogenation catalyst is disclosed in U.S. Patent No. 2,943,067. At col. 5, Example 1, performance of an alumina supported catalyst produced by the Bayer process (which produces gamma alumina) is described as being superior to a catalyst prepared from a gel-type alumina, which upon heating normally converts to an eta alumina. Thus, the '067 Patent also teaches the superiority of gamma alumina over eta alumina as the carrier for dehydrogenation catalyst.

The lack of thermal stability for catalyst produced from eta

alumina is also discussed in Oberlander, Richard K.: Aluminas for Catalysts-Their Preparation and Properties, page 69 (1983).

This preference for gamma alumina over eta alumina for carriers in the prior art is not surprising because gamma alumina is generally perceived as having a greater thermal stability than eta alumina. In fact, gamma alumina has become the standard alumina utilized for dehydrogenation catalyst.

Thus, it was a surprise to the applicants to discover that a dehydrogenation catalyst using eta alumina as the carrier onto which a chromium compound and a zirconium compound were added produced a superior product to a similar composition where gamma alumina was used. This surprising performance is discussed in the affidavit of applicant Fridman, which is attached as Exhibit A.

It was also surprising to discover that there is a synergistic relationship in the catalyst of the invention between the zirconium additive and the eta alumina carrier, resulting in a surprisingly large improvement in the performance and stability of a catalyst of the invention over conventional catalysts produced from gamma alumina, chromia and zirconium. This improvement is shown by the performance of aged catalyst of the invention in a conventional dehydrogenation reaction for the conversion of isobutane to isobutylene as shown in the Affidavit in the table at paragraph 7. In addition, there was also an improvement in the selectivity of the eta alumina-based catalyst and an improvement in yield.

Further, the catalyst of the invention was also more stable during the dehydrogenation reaction than conventional gamma alumina based catalyst.

Based on the teachings of the prior art, it was assumed that gamma alumina-based catalysts would outperform eta alumina-based catalysts. The applicants have surprisingly discovered the contrary, that eta alumina-based dehydrogenation catalyst containing chromia and zirconia preform better than gamma alumina-based dehydrogenation catalysts containing zirconia and chromia. This surprising improvement in the performance of the catalysts of the invention is sufficient to overcome the *prima facie* case of obviousness that has been asserted by the USPTO. See MPEP 2144.09 and In re Boesch and Slaney, 205 USPQ 215, 219 (CCPA 1980), the case cited by the USPTO in its Office Action.

**Further distinctions of Hindin, et. al.**

In addition, the catalyst that is disclosed in Hindin, et. al. is an oxidation catalyst. (See col. 13, line 41 through col. 14, line 7.) In contrast, the catalyst of the invention, as claimed in all claims, is a dehydrogenation catalyst, which is an entirely different type of catalyst. The statement in the preamble of the claims that the catalyst must be a "dehydrogenation" catalyst, must be taken into consideration in the review of the scope of the claims. It is clear from a review of the application that the

inventors were working on a particular problem relating to dehydrogenation catalyst and not catalysts in general. Thus, the preamble to the claim must be given patentable weight. See Corning Glass Works v. Sumitomo Electric, 9 USPQ 2d. 1962, 1966 (1989), where the Court determined that the language of the preamble imposed a structural limitation on the claims. In Corning Glass Works, the Court determined that the inventors claimed "an effective optical communication system" and not merely "a general improvements in conventional optical fibers." (Corning Glass Works, 9 USPQ 2d. at 1966.) Thus, the Court determined that the language of the preamble added to the structural limitations of the claims and limited the prior art that could be cited against the claims.

In a similar manner in this case, the type of catalyst that is being reviewed is a "dehydrogenation" catalyst, which differs dramatically from the oxidation catalysts of Hindin, et. al. This limitation in the preamble should be given weight and provides a further distinction of the claims over the disclosure of Hindin, et. al. in addition.

Please also note that Claim 4 of the application is specifically not taught by Hindin, et. al. Claim 4 requires the use of 0.1 to 1% of the zirconium compound. In contrast, Hindin, et. al. teaches from 2 to 15 wt.% of the group IV B metal oxide, preferably 5 to 15 wt.%. See col. 2, lines 43 - 45. Note also,

that in all examples, 10 wt.% of the zirconium compound was added to the composition. Thus, the claimed percentage of zirconium is not taught by Hindin, et. al. Accordingly, the applicants respectfully request that all rejections based on 35 USC § 103 over Hindin, et. al. be withdrawn.

Ahlberg and Zimmerman, et. al.

The USPTO has also rejected Claims 1 - 20 under 35 USC § 103 as being unpatentable over Zimmerman, et. al., taken with Hindin, et. al. and Ahlberg, and has rejected various claims as being unpatentable over Ahlberg taken with Hindin, et. al. It is not necessary to respond to the specific rejections based on Zimmerman or Ahlberg as the USPTO has acknowledged that these rejections rely on the "alleged" teaching by Hindin, et. al. of the use of eta alumina as a carrier. In fact, the USPTO acknowledges on page 3 that neither Ahlberg nor Zimmerman teach the use of eta alumina. Thus, the USPTO relied solely on Hindin, et. al. for teaching this critical component of the claims of the application. The applicants specifically adopt all previous arguments concerning Hindin, et. al. and respectfully assert that these arguments are sufficient to overcome all rejections of the claims under 35 USC § 103 either because there has not been a showing of *prima facie* obviousness or that, even if *prima facie* obviousness has been established, it has been overcome by the applicants' showing of

surprising results.

While it is the applicants' burden to overcome the overall teaching of all references cited in combination and not attack individual references, in this situation where the only teaching of the use of eta alumina is contained in one reference, all rejections can be overcome by distinguishing Hindin, et. al.

Teaching of Ahlberg in combination with Hindin, et. al. and/or in combination with Zimmerman, et. al.

Notwithstanding, the applicants assertion that each of the rejections have been overcomed by the failure of Hindin, et. al. to teach the use of eta alumina, the applicants also assert that the combination of Hindin, et. al. with Ahlberg alone or in combination with Zimmerman, et. al., also fails to teach the invention, as claimed.

There is no showing in Zimmerman, et. al. of any particular type of alumina that could be used as the support. The only disclosure of a support is that it must be  $Al_2O_3$ , col. 2, line 32. There is no discussion of any particular type of alumina. Thus, the teaching of Zimmerman, et. al. fails to add to the teaching of Hindin, et. al. concerning which type of alumina should be used as the support for the catalyst. Thus, the combination of Zimmerman, et. al. and Hindin, et. al. fails to teach the use of eta alumina as the support of the catalyst.

An even greater distinction exists when the teaching of Ahlberg is added to the teaching of Hindin, et. al. and/or Zimmerman, et. al. Ahlberg fails to even mention the use of eta alumina. The types of alumina that are disclosed include "corundum, alpha alumina, beta alumina and gamma alumina." Corundum is a form of alumina, normally thought of as a gem, as it is a ruby when it contains a red tinge and a sapphire when it contains a blue tinge. Among the synonym for corundum is "alpha alumina", see **Exhibit B**. There is no disclosure that corundum is equivalent to eta alumina.

In addition, Ahlberg specifically states that the carrier for the catalyst of Ahlberg is preferable comprised of gamma alumina. "Gamma-alumina, which is a particular good variety for use in the manufacture of alumina-chromina catalyst..." p.2, col. 1, lines 31-33. Thus, a person skilled in the art reviewing the disclosure of Ahlberg (where gamma alumina is preferred) in combination with Hindin, et. al. (where no preference for the type of alumina is disclosed) and or Zimmerman (where different types of alumina are not even disclosed) would be taught to produce a dehydrogenation catalyst using gamma alumina as the carrier. This teaching is certainly not surprising based on the previously cited prior art. In contrast, the applicants have discovered that a surprisingly improved catalyst is produced when eta alumina is used instead of gamma alumina. Thus, the overall teachings of the references cited

by the USPTO not only fail to disclose the use of eta alumina as a carrier, but in fact teach away from that use and teach the use of gamma alumina as the appropriate carrier for a dehydrogenation catalyst.

**Conclusion**

The applicants assert that they have overcome each rejection of the United States Patent and Trademark Office and request that a Notice of Allowability be issued. If there are any questions concerning this matter, please contact applicants' counsel.

Respectfully submitted,

  
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